

**Description:** In CHEM 242, Chemistry and Biochemistry majors learn how to plan and perform chemical synthesis reactions, how to isolate and characterize the resulting products, and how to evaluate and report the results.

**Course Objectives:**

- To establish best practices for working safely in lab—including maintaining good chemical hygiene, wearing personal protective equipment, knowing the locations of and proper use of safety showers, eye washes, fire extinguishers, etc., maintaining good ventilation, and proper waste disposal.
- To develop and apply laboratory techniques necessary to synthesize, purify, and characterize chemical compounds including:
  - Controlling reaction temperature,
  - Methods for monitoring the progress of reactions,
  - Spectroscopy methods for characterizing reaction products,
  - Controlling reaction pH,
  - Protecting reactions from moisture and the atmosphere.
- To utilize computational chemistry to help predict the products of a reaction.
- To develop quantitative reasoning skills by determining the amounts of reagents required for a reaction, reaction concentrations, reaction yields, etc.
- To develop record keeping and scientific writing skills.
- To search the chemistry literature for existing synthesis laboratory procedures.
- To prepare an oral presentation on a proposed synthesis.
- To render a published procedure into an executable laboratory experiment.
- To report the results of a synthesis with a written report.
- To perform laboratory work in a research environment.

**Academic Calendar:** It is the student's responsibility to know the course schedule, which is posted on Sakai, and the official University Academic Calendar.

**Meeting Times and Locations:** All sections of CHEM 242 meet in LSB 115.

Section	Day	Time
001	Mondays & Wednesdays	8:30 AM – 11:30 AM
002	Mondays & Tuesday	5:45 PM – 8:30 PM

**Office Hours:** Office hours for the instructor and Teaching Assistants will be posted on Sakai.

**Required Items:**

- Bound composition notebook (not spiral bound and with no tear-out perforations).
- Access to Microsoft 365. This is provided by Loyola to students.
- Access to Sakai.
- Safety goggles. We will provide a pair of goggles to you each day that have been UV sanitized between sections. If you wish to get your own, they must be Type G, H, or K goggles and must meet the requirements of ANSI Z87.1.
- Long-sleeved, full-length laboratory coat or lab apron. We provide lab aprons, but they must be worn with a long-sleeved shirt to be effective.
- Appropriate clothing and footwear as described in the laboratory safety rules.
- A non-erasable, waterproof pen.

This course contains elements that require a desktop or laptop computer with high-speed Internet access. Some of the materials used in this course MAY NOT WORK on tablets or mobile devices. If you do not have a desktop/laptop computer or Internet service, you will need to go to the Information Commons on campus or contact the extended loan equipment program within the first few days of the start of the course and arrange for these resources.

**Course Homepage:** Announcements, assessments, extra copies of the handouts, the grade book, etc. are posted on [Sakai.luc.edu](http://Sakai.luc.edu). Students should check Sakai frequently as it is central to how the course operates.

**Please note that all course materials should be accessed using the Lessons tab**, where details are broken down by topic/experiment. Some assignments may not open properly if accessed through other tabs.

**Safety Rules:** Students must read and agree to follow the lab safety rules before they can work in the lab. On lab safety day, students must sign a Lab Safety Contract which acknowledges that the student received the safety rules, and that the student agrees to follow them. A lab safety contract must be signed by a student before they can work in the lab. Anyone who does not adhere to the safety rules will receive point deductions and may not be allowed to remain in the laboratory, depending on the severity of the violation. Students must also dress in appropriate clothing and footwear such that there is no exposed skin at any point below the shoulders. Any student who comes to lab without these items will automatically not be allowed to perform the experiment. More information on the course attendance policy and safety points can be found below.

**\*\*\* WHENEVER CHEMICALS ARE PRESENT, NO ONE MAY ENTER LSB-115 UNLESS THEY ARE WEARING THE FOLLOWING: \*\*\***

1. **EYE PROTECTION (These must be Type G, H or K goggles and must meet or exceed ANSI Z87.1)**
2. **FULL-LENGTH LAB COAT OR APRON**
3. **CLOSED-TOE, CLOSED-HEEL SHOES**
4. **APPROPRIATE ATTIRE THAT FULLY COVERS THE SHOULDERS AND MIDSECTION AND ALL SKIN BELOW THE WAIST**

**Grading:** Course grades shall consist of the following components:

Lab Notebook for Individual Experiments, drop lowest one	25%
Post-lab Exercises, drop lowest one	25%
Lab Reports	20%
Synthesis Proposal and Presentation	20%
Safety Points	10%
	100% total

A>93%, A->90%, B+>87%, B>83%, B->80%, C+>77%, C>73%, C->70, D+>67%, D≥60%, F<60%

**Attendance:** Students are expected to attend every lab session. **Any student who does not dress appropriately or does not complete the pre-lab preparation on time will be marked absent.** Missing a lab period for any reason will result in an automatic zero for any work that is not completed. However, students can drop one score from Lab Notebook for Individual Experiments and Post-Lab Exercises.

There will be an attendance sheet students must sign upon entering the lab. The attendance sheet must match who is present in the lab in an emergency. If anyone must leave the lab after signing in (e.g., to use the restroom, get a drink of water, etc.) that person must be sure to talk to their TA to log out on the attendance sheet. For safety's sake, to obtain better results and to be fair to both lab partners, students should limit time out of the lab. Students who leave the lab for a period longer than 10 minutes will receive a deduction from the safety points for that experiment.

Additionally, to ensure fairness to everyone, students who arrive late may be asked to perform an experiment solo. **Students must arrive within 15 minutes of the start time for lab to do the experiment; any student arriving more than 15 minutes late will be marked absent.**

**Pre-Lab Preparation:** Success in lab depends on advance preparation. Students who come to class prepared get better results, get done faster, and, most importantly, tend to have fewer accidents. Therefore, there are several things that students must do BEFORE coming to the lab. One major component of the pre-lab assignment is to thoroughly examine the materials posted about the experiment on Sakai. Before coming to class, students must complete all the materials included in the "Pre-lab Preparation" section of Sakai for that experiment. All handouts must be opened and read. Videos must be viewed to 100% completion. The pre-lab portion of the notebook must be completed before class and will be checked at the door before entry into the lab. Students are not allowed to finish the pre-lab preparation after class has begun. **Students who do not complete the pre-lab preparation will not be allowed to perform the experiment.**

Lab Notebook: The ability to keep good records is a valuable skill. Proper documentation of experiments will make experimental results easier to interpret and, very importantly, will facilitate replication of the experiment. (Reproducibility is central to the scientific method!) One of the most important facets of experimental work is that everything should be recorded as completely and accurately as possible. Sometimes, important discoveries are made when things do not go exactly as expected. Therefore, it is critical that students report their actual data and not what it is thought that the correct answer should be. The Lab Notebook **MUST ACCURATELY REFLECT WHAT HAPPENED DURING THE EXPERIMENT**. Procedure descriptions should be written entirely in past tense to document the experiment as it was performed. Lab notebook entries are not meant to be written as instructions for others, but as a written record of what happened while performing the experiment.

As mentioned, the TAs/Instructor will check the pre-lab portion of the lab notebooks before the experiment begins. The remainder of the Lab Notebook will be completed **DURING LAB**. After the experiment is completed, each student must show their Lab Notebook to the TA/Instructor before the student leaves lab to receive credit. The TA/Instructor will record the notebook score and immediately return the notebook so that the student can use it to help with completing the post-lab exercises. The lowest score in this category will be dropped from the overall grade calculation.

Post-lab Exercises: While performing an experiment, students are often focused on the tasks being completed and do not always pause to consider why certain things are done in specific ways. To reinforce the concepts and techniques that were performed in lab and to allow more time to think through the experiments, students will also complete post-lab exercises outside of class. Completed post-labs will be submitted and graded via Gradescope. Students will have 1 week to complete and submit the post-lab work. Late submissions will only be accepted up to 1 week after the posted due date, and a 50% deduction will be automatically applied. No late post-lab work will be accepted after this. The lowest score in this category will be dropped from the overall grade calculation.

Lab Reports: Students will compose two type-written lab reports that convey the results and importance of the experiment. A lab report formalizes one's experiment with written documentation that is accurate and understandable to others. The two experiments for which there will be lab reports are "Structure Elucidation of Reaction Products" and both parts of the "Multi-step Synthesis of Aspirin." Late lab reports submitted within 1 week of the posted due date will receive an automatic 25% deduction; reports submitted 1-2 weeks after the posted due date will receive an automatic 50% deduction.

Synthesis Proposal: A major component of this course will be for students to explore the chemical literature for published synthetic procedures, choose a two-step synthetic procedure, revise it as needed, and perform the experimental steps and analysis for the synthesis in the laboratory. Students will have to evaluate their various resources (time, equipment, cost, etc.) and gain laboratory work experience in a research environment.

Lab Safety Points: Laboratory safety is an extremely serious and important topic. All violations of the safety rules will result in point deductions. Some safety violations may also result in the student being expelled from the lab. As employees, the instructors and Teaching Assistants are expected to enforce the safety rules and disciplinary actions may be taken against them by Loyola if the safety rules are not enforced. Therefore, please do not ask the instructors or Teaching Assistants to ignore any safety rules or to not apply any penalties for safety infractions. They are not optional. Some examples of safety violations that result in immediate point deductions include things like removing safety goggles in the lab, touching your phone with your gloved hands, eating, or drinking in lab, etc. These are just some examples—the list is not all-inclusive because it is impossible to foresee every potential safety violation. Some examples of safety violations that will result in immediate expulsion from the laboratory include things like wearing inappropriate attire, dumping chemical waste down the sink, etc. Again, these are just some examples. There are other safety violations that could come up that may result in a student being asked to leave the lab. In addition, incurring three, lesser safety violations in one lab period will result in a student being asked to leave the lab, even if the infractions would not warrant expulsion individually. Any student removed from lab for safety violations twice will automatically

receive one lower letter grade. If a student is removed from lab for safety violations a third time, they will automatically fail the course. Each experiment will have three safety points at stake.

Re-grades: All requests to have any submitted assignment re-graded must be submitted in writing before the hard deadline. Students should email the instructor, not the TA.

Late Policy: Post-lab exercises and lab reports will be accepted late following the policies outlined above. Lab notebook and safety points are scored at the end of each completed lab experiment; students must be present to earn these points, and no late scores will be accepted.

Hard Deadline: All materials of any kind must be submitted by 5 PM on Friday, December 6, 2024. No materials will be accepted after this time. Final grades will be calculated based only on materials submitted by this deadline. If there are substantial materials missing that cannot be submitted before this deadline, the student should consider withdrawing from the course or requesting an Incomplete by completing this form before the end of the term.

Email: Faculty email addresses are posted on the open Internet for every software bot and spammer in the world to see. Therefore, faculty Outlook accounts are configured differently, and an outside contractor also scans faculty email. Emails from outside sources are often blocked automatically. Because of this and a federal law relating to student privacy (FERPA), students must use a Loyola email address when contacting the TAs or the instructor about this course. In the subject line of an email, please put your section number and TA's name.

Interactions with TAs: To increase the amount of individual assistance you receive in lab, Teaching Assistants will participate in delivering this course. If at any time during the semester you have any questions or concerns about the behavior of your Teaching Assistant, please contact the instructor.

Academic Integrity: All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at: <http://www.luc.edu/cas/advising/academicintegritystatement/>

*“A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students at Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty. Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.”*

Regarding the use of Artificial Intelligence: our Provost has expressed to “Let us all make sure we are learning and sharing best practices and not allowing AI to do the learning for us.” In this course, any work you submit for credit must represent your own ideas and understanding of the assigned material. If you are uncertain about any case where your use of AI may conflict with university or course standards, please see your instructor to discuss your concerns.

Any instance of dishonesty (including those detailed on the website provided above) will be reported to The Chair of The Department of Chemistry & Biochemistry, who will decide what the next steps may be. The penalty may include a grade of zero for that assignment and/or failure of the course.

Notice of Reporting Obligations for Responsible Campus Partners: Course instructors are Responsible Campus Partner (“RCP”) under Loyola’s “[Comprehensive Policy and Procedures for Addressing Discrimination, Sexual Misconduct, and Retaliation](#)” (available at [www.luc.edu/equity](http://www.luc.edu/equity)). As an RCP, instructors are required to report certain disclosures of sexual misconduct (including sexual assault, sexual harassment, intimate partner and/or domestic violence, and/or stalking) to the [Office for Equity & Compliance](#) (“OEC”). As the University’s [Title IX](#) office, the OEC coordinates the University's response to reports and complaints of sexual misconduct (as well as discrimination of any kind) to ensure students' rights are protected. See the website above for more information.

If you ever wish to speak with a confidential resource regarding gender-based violence, call The Line at 773-494-3810. The Line is staffed by confidential advocates from 8:30am-5pm M-F and 24 hours on the weekend when school is in session. Advocates can provide support, talk through your options (medical, legal, LUC reporting, safety planning, etc.), and connect you with resources as needed -- without generating a report or record with the OEC. More information about The Line can be found at [luc.edu/wellness](http://luc.edu/wellness).

Health, Safety, and Well-Being On-Campus: Please be familiar with and adhere to the policies posted on the Campus Info & Resources site: <https://www.luc.edu/healthsafetyandwellbeing/campusinforesources/>

Course/Instructor Evaluation – SmartEval: The following information came from the University regarding course evaluations, “Towards the end of the course, the students will receive an email from the Office of Institutional Effectiveness reminding them to provide feedback on the course. They will receive consistent reminders throughout the period when the evaluation is open, and the reminders will stop once they have completed the evaluation.

- The evaluation is completely anonymous. When the results are released, instructors and departments will not be able to tell which student provided the individual feedback.
- Because it is anonymous and the results are not released to faculty or departments until after grades have been submitted, the feedback will not impact a student’s grade.
- The feedback is important so that the instructor can gain insight into how to improve their teaching and the department can learn how best to shape the curriculum.”

Course Repeat Rule: Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). The Department advises that it is preferable to complete a course with a grade of C or C-, and to demonstrate growth in future coursework, than to withdraw from a course.

After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <https://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Student Accommodations: Loyola University Chicago provides reasonable accommodations for students with disabilities. Any student requesting accommodations related to a disability or other condition is required to register with the Student Accessibility Center (SAC). Professors will receive an accommodation notification from SAC, preferably within the first two weeks of class. Students are encouraged to meet with their professor individually to discuss their accommodations. All information will remain confidential. Please Note that in this class, software may be used to audio record class lectures to provide equitable access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class activity. Recordings are deleted at the end of the semester. For more information about registering with SAC or questions about accommodations, please contact SAC at 773-508-3700 or [SAC@luc.edu](mailto:SAC@luc.edu).

Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC): Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and how they can be remedied. Students must provide their instructors with proper documentation, i.e., [“Athletic Competition & Travel Letter”](#) describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member, and it must be provided to the professor in the first week of a semester. It is the student’s responsibility to make up any assignments. If the student misses an examination, the instructor must allow them to take it at another time. (<https://www.luc.edu/athleteadvising/attendance.shtml>)

Students who will miss class for an academic competition or conference must provide proper documentation to their instructor as early in the semester as possible.

Accommodations for Religious Reasons: If you have observances of religious holidays that will cause you to miss class or otherwise affect your academic work in the course, you must alert the instructor no later than Friday of Week 2 in the semester to request accommodations. Advance notice must be sent to the instructor through Loyola email by this deadline.

Privacy Statement: Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity initiated by the instructor may be retained by them only for individual use. Additionally, all materials from this course cannot be shared outside the course without the instructor's written permission.

Instructor Contacts: Mr. Tim Thomas, LSB-124, 773-508-8115, [tthoma1@luc.edu](mailto:tthoma1@luc.edu)

### Experiments

1. Effect of Temperature on Reaction Rates
2. Control of Reaction Temperature
3. Reaction Workup Using Reactive Extraction
4. Structure Elucidation of Reaction Products using  $^1\text{H}$  NMR Spectroscopy
5. Natural Product Extraction and Recrystallization
6. Reaction Monitoring by TLC ( $\text{S}_{\text{N}}2$  Reaction of 2-Naphthol and Butyl Tosylate)
7. Multi-Step Synthesis of Aspirin (Step 1: Hydrolysis of Methyl Salicylate)
8. Multi-Step Synthesis of Aspirin (Step 2: Acetylation of Salicylic Acid)
9. Student-Proposed Syntheses